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Approximate limits of territory within which
the contractor shall confine his operations
shown thus
Level existing line

CITY OF NEW YORK
BOARD OF WATER SUPPLY
ASHOKAN RESERVOIR
MAIN DAMS
GENERAL PLAN
Scale 1" = 1000'
Contract No. 100
Date: 1911

THE CITY ENGINEER: J. C. HARRIS
THE CITY COMMISSIONER: J. C. HARRIS

ILLUSTRATED AND DESCRIPTIVE

ACCOUNT OF THE

Main Dams and Dikes

OF THE

Ashokan Reservoir

BROWN STATION, N. Y.

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Ashokan Dams and Dikes

FOR THE past two generations New York City has used Croton River for its supply of water, Brooklyn being supplied principally by the Ridgewood system of wells. The tremendous growth of the city, with the increased demand for pure water, caused the officials to take up the matter of providing an additional supply and to eventually give New York City the best and greatest water-supply ever known.

The matter was finally brought before the Legislature at Albany and chapter 724 of the Laws of 1905 and as follows became a law:

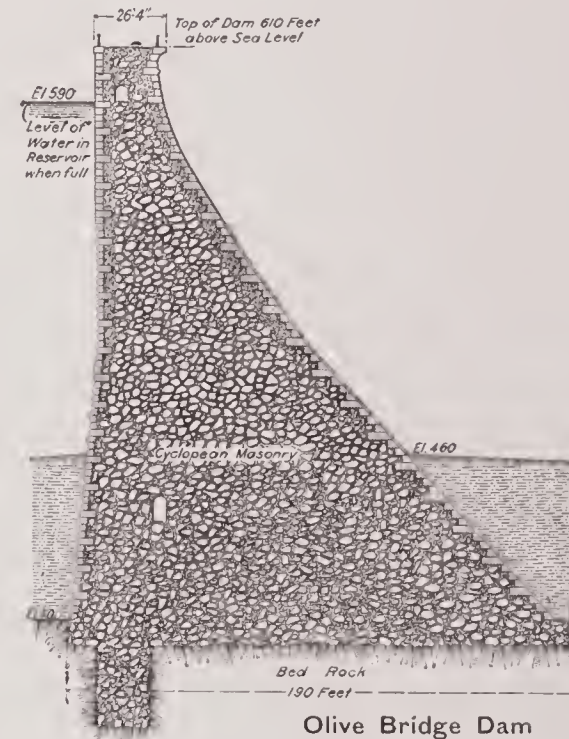
Laws of 1905. Chapter 724.

AN ACT to provide for an additional supply of pure and wholesome water for the City of New York; and for the acquisition of lands or interests therein, and for the construction of the necessary reservoirs, dams, aqueducts, filters and other appurtenances for that purpose; and for the appointment of a commission with the powers and duties necessary and proper to attain these objects.

Accepted by the city. Became a law June 3, 1905, with the approval of the Governor. Passed by a two-thirds vote.

SECTION 1; *The Board of Water Supply of the City of New York.* The Mayor of the City of New York shall appoint three persons, who shall be commissioners for the purpose hereinafter specified. The persons so to be appointed shall be public officers and shall constitute a board or commission to be called the Board of Water Supply of the City of New York. Etc.

On June 9, 1905, Hon. George B. McClellan, Mayor, acting under Section 1, Chapter 724 of the Laws of 1905, appointed J. Edward Simmons, Charles N. Chadwick and Charles A. Shaw commissioners



to constitute the Board of Water Supply of the City of New York, from lists submitted by the Chamber of Commerce, the Board of Fire Underwriters and Manufacturers' Association of New York.

Immediately upon appointment, the board organized with the appointment of J. Edward Simmons* as President, and Charles N. Chad-

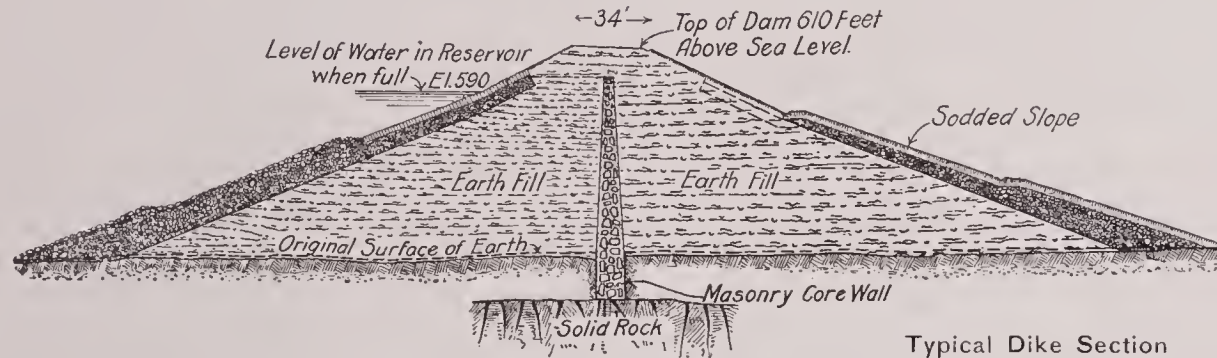
* Resigned and succeeded by John A. Bensel.

wick as Secretary. Following instructions that they secure the best engineering talent, the Board appointed J. Waldo Smith chief engineer and John R. Freeman consulting engineer to the Board, and William H. Burr and Frederick P. Stearns consulting engineers on the advisory board of the chief engineer.

On August 9, 1905, the Board passed a resolution directing a general plan for securing an additional supply of water from the Catskill Mountain district and instructed the chief engineer to submit plans and profiles.

On October 9, 1905, or four months after their appointment, and pursuant to Chapter 724 the Board submitted its report, together with the report of the chief engineer, to the Board of Estimate and Apportionment, accompanied by a large map and profiles setting forth the complete scheme for an additional supply from the Catskill Mountains.


On October 27, 1905, the Board of Estimate and Apportionment passed a resolution approving and adopting the report, map and profiles and directing the map to be signed and filed in accordance with the law.





A Typical Walking Boss (Mounted) at Ashokan.

Ashokan Reservoir

HE ASHOKAN RESERVOIR, the principal reservoir in the Catskill scheme, is situated in the foothills of the Catskill Mountains, about 14 miles west of the Hudson River at Kingston, N. Y., in the County of Ulster and in the valley of Esopus Creek.

The reservoir is about $12\frac{1}{2}$ miles long and varies from one to two miles in width. When full, it will have a water area of 12.8 square miles and a shore line of 40 miles. The total area to drain into the reservoir is approximately 250 square miles and when full has a capacity of 128 billion gallons of pure fresh mountain water. The water will have a maximum depth of 190 feet and an average depth of 50 feet with high water level at elevation 590 feet above sea level.

The reservoir will be divided into an east and a west basin by the Dividing Weir and Dike. The west basin will be formed by the building of the Olive Bridge Dam with the north and south wing across the gorge of the Esopus Creek and will have a length of about one mile; the west dike across the valley of the Hog Vly Kill will also form a part of this basin. The east basin will be formed by the building of the Beaver Kill Dikes across the valley of the Beaver Kill and the east dike waste weir near the Stone Church Spillway, which will carry the overflow of the reservoir back into the old channel of the Esopus. At the intersection of the west and middle dikes, at a point opposite the present station of the Ulster & Delaware R. R. at Brown Station, the aqueduct has its origin and from here the water is carried by the Catskill Aqueduct a distance of nearly 100 miles to New York. Leading off towards the hill from the gate-chamber at the head of the aqueduct is the dividing weir and dike, which divides the basins; a channel called the east and west channel in each basin meet here and water can be drawn from either basin, or both. A discharge channel near here will take the overflow of the west into the east basin. Just below the head works of the aqueduct and where the village of Brown Station now stands will be installed the large areating basins to remove tastes and odors, if there be any, from the water.

To prepare this reservoir for the impounding of the water will ne-

cessitate the removal of seven villages, besides countless farm houses and scattering dwellings.

The dead will not even be permitted to rest and there will be several thousand bodies removed from the large number of small cemeteries within the area of the reservoir. In addition to the removal of all buildings etc., all trees and vegetable matter of every description will be removed and the roots burned or hauled away; when man has finished this work the bed of the Ashokan Reservoir will be more barren of vegetation than the arid desert of Sahara. Many a tear will be shed and many a heart will ache when the life-long residents pack their belongings and load them on wagons, to be hauled from the old homes. Some of these residents have never known another home and must in their old days start to build in other parts and among strangers. Then comes the man with the firebrand and the old home is reduced to ashes and nothing more remains except the old cellar-walls and the memories of time gone by.

It will also be necessary to take up and remove about 13 miles of the road-bed and track of the Ulster & Delaware R. R. and to replace miles of highways and county roads, which will mean the building of several bridges, besides the bridge which will traverse the dividing weir and the highway across the top of the dams and dikes.

In the summer of 1907 the Board of Water Supply advertised for bids for the building of the dams and dikes; sealed bids were received at their office on August 6, 1907, and then publicly opened and read. Each bid was accompanied by a certified check for \$250,000.00, that in case the contract was awarded, the contractor would carry out and fulfill his agreement for the proper execution of the contract and furnish the necessary bonds of \$1,000,000 for the faithful performance of the work. The Board reserved the right to reject any and all bids or to select the bid or proposal, the acceptance of which would, in its judgment, best secure the efficient performance of the work.

The Board then took all of the bids under advisement and investigated the various bidders as to their past records and capability of

doing the work, as time in which various portions of the whole of the contract are to be carried out and the work completed, was the essence of the agreement.

After about 20 days investigation etc., the board awarded the contract to MacArthur Brothers Company and Winston & Company, of New York and Richmond, Va., for \$12,669,000.00.

The approximate estimate of the amount of work to be done and which was used as a basis for computing bids is as follows:

| | |
|---|-----------------------|
| Earth excavation | 2,055,000 cubic yards |
| Rock excavation | 425,000 cubic yards |
| Earth & rock embankments | 7,265,000 cubic yards |
| Portland cement | 1,100,000 barrels |
| Concrete masonry | 882,000 cubic yards |
| Paving and riprap | 105,000 cubic yards |
| Metal work | 914 tons |
| Clearing | 200 acres |
| Vitrified drain tile | 21,500 lineal feet |
| *Crushed stone | 11,000 cubic yards |
| Timber & lumber | 950,000 feet, B. M. |
| Stream Control of the Esopus and Beaver Kill. | |

The amount of work to be done in the 84 months is shown as follows:

| | | |
|--------|----------|------------|
| End of | 9 months | 2 per cent |
| " " | 16 " | 9 " " |
| " " | 28 " | 23 " " |
| " " | 40 " | 41 " " |
| " " | 52 " | 61 " " |
| " " | 64 " | 80 " " |
| " " | 76 " | 96 " " |
| " " | 84 " | 100 " " |

On being notified of the award of the contract, MacArthur Bros. Co. and Winston & Co. at once began shipping plant from other works to Brown Station and placing orders for lumber etc. for use in the building of the camps etc. A party of engineers were also sent to the site to make the necessary surveys for the railroad, changing high-ways and the general layout of the plant and camp. Employees began arriving from all parts and sought shelter among the few scattered inhabitants of Brown Station; many had to travel to and from Kings-

ton, as there were no available places for them to live. Mules and wagons were driven across country from the Cross River Dam, which was about completed and many of the employees from there with their families came as fast as places for them to live could be provided. In order that this class of men could get their kinds of food-stuffs, not carried by the ordinary country store, a temporary commissary was opened in a building near the station, in which the contractors had opened their office pending the erection of the buildings in the main camp. Actual work was started on the railroad on September 26, 1907: clearing the right of way and the work of grading for the track was pushed, in order that a siding might be obtained and room made for the storage of all plant, which was arriving daily in train-loads and filling nearly all of the sidings on the U. & D. R. R. A derrick was also erected near the station, in order that these cars could be unloaded. The clearing of the sites of the dikes was started on October 2, and a few days later work was commenced on the erection of houses in the camp for the employees. In less than a week several of these were ready for the tenants. At this time the attention was directed chiefly to getting accommodations etc. for the employees and all available men and carpenters were put to work on the buildings. In the meantime the plant kept arriving and men kept coming in and work was also started on the office on October 12. About this time the plans for the work were gone over and work was started on the machine shops a few days later. The site of the head-towers of the cableways at the dam was drained, preparatory to making a start on the embankment which had to be built for them and the embankment work was started the latter part of the month. By the first of November the work on the foundation of the power plant was started and, although the work was retarded on account of extremely cold weather, very good progress was made and the installation of the plant and air lines was completed and the plant put into actual operation on April 12, 1908. The commissary and bakery were both started in the very early part of November, as the question of providing the necessities of life for the then increasing number of men was very difficult in the small temporary store near the station. The excavating and grading of the block-yard and the stripping of the middle dike both date back to this time.

The attention of the contractors was then directed to the Olive Bridge Dam and work was started on the re-enforcing of the coffer dams on November 22, and on the same day the employees from Katonah heard an old familiar sound when locomotive No. 23 whistled

* Does not include crushed stone in any of the masonry.



Excavating the Foundation of the Olive Bridge Dam. (8-ft. steel pipes carrying the stream to the right.)

for Brown Station, having made the trip under her own steam. By the first of the year the boarding house kitchen, dining-room and dormitory were under construction and ice houses were built and being filled to provide for the hot summer to follow.

The derricks at the dam were assembled and on February 25, 1908 the first one was erected. Shortly after this, on March 7, work was started on the construction of the main cable-ways at the dam and four days later the main crushing and mixing plant, for which plans had been drawn during the winter, was started. The first cable-way tower was raised on April 18, the other tower a few weeks later, and the cable-way was in actual operation in the early part of June.

As the installation of the plant progressed and men kept arriving, work was started at various places and the excavation of the Olive Bridge Dam was started on March 23. The excavation of the drain trenches at the north and south wing and the middle dike, as well as the building of the Beaver Kill road were all started about this time and when the whistle blew at 5 p. m. one could see men coming from all directions, having finished their days' work.

The quarry site was decided upon and a railroad line was surveyed to it and the work of grading for the track commenced in the early part of April. The site of the quarry was cleared of all trees, where-upon the work of stripping or removing the earth was started and by the time the railroad was completed, enough stone had been quarried to keep the masonry going on at the dam. The earth covering the ledge in the gorge at the site of the dam was being removed and Sullivan channeling machines were put in here in addition to the many Ingersoll-Rand drills; rapid progress was made in the foundation, the channeling machines cutting on the up and down stream faces of the dam and the drills between gradually working down into hard solid rock for a foundation for the massive structure of solid masonry.

On May 5, the Bishop Falls House, an old landmark where many people from the city spent their summer vacations, and which afforded a retreat for a great many of the employees of the contractors in the first stages of the work, was torn down and really was the first building to be removed in order to make room for the plant of the contractors. The building stood where the tail-towers of the cableways at the dam now stand.

With the coming of warmer and better weather, work was pushed in all parts, and during the month of May the diverting channels of the Hog Vly Kill and Beaver Kill were started. The Hog Vly, which

formerly emptied into the Beaver Kill, now empties into the Esopus about two miles above the dam. The Beaver Kill now runs through a conduit built in the middle dike. This will eventually be closed. During the month work on the embankments on the middle dike was started and the excavation on the Beaver Kill gorge through 80 feet of glacial drift was also commenced a little later. During the early summer the camps at the South wing, east portion, middle dike and the east dike were started. At each place work was started on the removal of the top soil, the excavation of the core walls, the installation of the plants, buildings etc. and the work of putting in concrete and building embankments.

The sand pit had been stripped of its surface soil and sand was being hauled from here to the various places where concrete was being used. Work at the dam progressed very rapidly and the rock was excavated to a depth far below the two 8 foot pipes which carried the stream over the heads of the men at work there. Masonry was started September 4 and filled into the excavation and before the end of the season it had risen to a point above the river bed. A conduit built in the masonry provided for the stream and the two pipes were removed and stored for future reservoir building.

During the summer the main camp continually increased in size and additional plant was installed. The quarry was in operation and work was started on the west dike, aqueduct, dividing weir and the discharge channels and by the time the first snow fell at Brown Station everything had changed. The cold weather did not stop the work, however, and during all the cold wintry days the whistle on the power plant sounded its shrill blasts and the workers, wrapped up in heavy clothes and caps, with only their eyes visible, could be seen plodding through the snow to the places where the snow had been cleared away and with air drills and dynamite they worked their way into the rock foundations. The machine and repair shops were kept in full blast overhauling and repairing plant, wagons etc.

As soon as the birds began singing in the valley and the snow was off the lofty peaks, the wanderers, who had taken leave in the fall and returned to the sunny south, began arriving, bringing with them their friends, and it reminded those who remained, that, as ocean currents change their courses and positions, so does humanity. With additional plant installed and increased forces, the season of 1909 will always be remembered as one of hustle and push on the Ashokan.

During the year there has been an average daily shipment of twelve car-loads of Alsen cement. To give an idea of the vast

amount of cement to be used in the work, it is interesting to note that if all the cement were to be shipped in railroad cars at one time and made up into one train, it would make a train 55½ miles in length, or it would take 916 trips of the largest locomotive on the U. & D. R. R. to haul it from Kingston to Brown Station.

If all of the earth and rock to be handled were built into a pyramid, it would be ¼ mile square at the base and ¼ mile high, or if it were to be loaded on railroad cars in like manner as hauled on standard railroads, it would make a train of cars reaching from New York to San Francisco, and back to St. Louis, Mo.

A saw mill has been installed und wood lots have been bought and the timber hauled to the mill and cut up into various sizes for the different kinds of work.

The work is divided into 8 hour shifts and two and sometimes three shifts are worked in the 24 hours.

Up to the latter part of November 1909, the following amount of work had been done:

| | | |
|-----------------------------|-----------|-------------|
| Earth excavation | 630,184 | cubic yards |
| Rock excavation | 85,362 | " " |
| Embankment built | 1,065,423 | " " |
| Masonry built in structures | 271,723 | " " |
| Concrete blocks built | | |
| and stored in yard | 12,600 | " " |
| Cement delivered and | | |
| used in the work | 308,007 | barrels |
| Acres cleared for work | 149 | acres |
| Vitrified pipe drains | 12,000 | lineal feet |
| Riprap and paving | 1,000 | cubic yards |
| Crushed stone | 8,000 | " " |

During the month of October 1909 there was placed in the main dam 35,259 cubic yards of Cyclopean masonry and concrete blocks, which figure comprises the largest number of yards ever placed in any single structure of its kind in the world and this rate of progress shows that the plant installed for carrying on this part of the work is adequate for doing all the work in less than the contract time. The same condition prevails on practically all parts of the work.

Yale Quarry, which furnishes the stone for the dams and the various concrete work, is located nearly three miles from the site of the dam, at about elevation 740, or nearly 200 feet higher than the rail-

road tracks at the dam. A standard gauge railroad connects it with all parts of the work where stone is used. The quarry has an almost vertical face of about 40 feet and is more than a quarter of a mile long. The railroad track runs along the side of the quarry and is double-tracked. Cars are placed on one track to be loaded and as they are loaded and taken out by the locomotives, another train is left on the other track, giving a continuous performance. There are installed here 10 guyed derricks of the largest kind on the work, having a capacity of about 10 tons each and being connected to American Hoist & Derrick Co. engines. These are in one line and just far enough apart so that the boom of one will reach the boom of the other when out at full length of the boom. These derricks are used for handling the large 5-yard skips into which the stone is loaded, also for loading large stone into the skips and placing the skips aboard the cars, three skips to the car. The rock is drilled with Ingersoll-Rand Drills, then blasted and worked up by hand and with derricks. The quarry has a daily average output of about 1000 cubic yards during the working season. The first train-load of stone was hauled from the quarry to the dam on October 2, 1908.

A crushing plant has also been installed here, the plant consisting of a No. 7½ and a No. 5 McCully crusher, with a capacity of crushing 70 cubic yards per hour. The stone is taken to the crusher directly from the derricks and crushed. There is a side-track on which are placed large bottom dump cars; the crushed stone is loaded into these and hauled in the quarry trains to the various parts of the work, where needed.

Sand is obtained from a pit less than a mile distant from the main dam and there is a branch of the railroad connecting it also. There is a large deposit of good clean sand, which, for concrete purposes, requires no screening, and which is loaded into dump cars at the pit with a Page Excavator. The daily output of the sand pit varies according to the conditions at the various concrete plants, where it is mixed into concrete.

The Olive Bridge dam, being the portion of the dam across the valley of the Esopus, has a total length of nearly a mile. The main dam, or the heavy masonry portion, is about 1000 feet in length across the gorge of the stream and the north and south ends are earth dams with concrete core wall, similar to the dikes, and are known as the north and south wings. The excavation for the foundation of the dam was carried to elevation 358½ and as the top of the dam will be at elevation 610, the maximum height will be 251½ feet. It is about



Main Dam (looking North), showing crusher and block yard in distance.

190 feet wide or thick at the base and the top, over which will be built a highway, is 26 feet wide. The dam rests on solid rock with a cut-off trench near the upstream face, forming a heel or anchorage for the dam, and at the same time cutting off all seams or crevices which may have been in the rock and preventing any possible leakage. It is built of Cyclopean masonry, being concrete with large stone imbedded. The up and down stream faces are built of concrete blocks, which are made at the works. To prevent any cracks or breaks in this huge volume of masonry, expansion joints have been built, extending across the full width of the dam as well as to the extreme height and are built every 90 feet for the entire length. Inspection galleries to detect any leaks or seepage are also provided and several of these are and will be built through the masonry for the entire length of the dam. A conduit is built through the dam in the old river bed and through this now flows the stream. As soon as the time arrives for the storing of the water, this conduit will be closed with solid masonry. The flow of the stream varies greatly, from 150 cubic feet per minute during the summer months to 38,000 at the greatest flood times.

The site of the main dam was at first enclosed between two coffer dams, about 360 feet apart, and the stream was carried in two eight foot steel pipes. These latter carried the stream until the excavation was completed and the masonry built to their level and were then taken out and stored for future use. The stream was at this time turned through the conduit already described.

Heavy earth and rock embankments are built against the up and down stream faces of the dam to add weight and resistance.

The work at the dam is commanded by 4 Lidgerwood travelling cable-ways, each having a clear span of 1534 feet or more than a quarter of a mile. The towers, two for each cable-way, are 90 feet high and each contains about 60,000 feet of the very best grade of timber. These towers travel on tracks, of which there are three sets, one of 3 rails and two of 2 rails, the tracks having a total length of about 600 feet. Each cable has a maximum carrying capacity of 10 tons. Steam shovels and steam rollers and the various other heavy plant used in the *hole* are easily moved and handled with them; sometimes two or more cable-ways are used at the same time. The greater part of the excavation was handled with the cable-ways and steam shovels. All of the stone, concrete and blocks are handled with them, being taken from the railroad and concrete tracks near the head-towers and delivered to the derricks, where the material is put into the solid mass of masonry. There are 16 wooden stiff-leg

derricks with 60 foot booms and having a carrying capacity of 10 tons each, being equipped with American Hoist & Derrick Co. hoisting engines. Some of these derricks are located on towers and others partly on the hillsides and the masonry, and as the work progresses, are from time to time moved with the cable-ways. The main crushing plant at the dam consists of a battery of crushers, comprising a No. 9 McCully and two No. 6 Austins and crush 100 cubic yards of stone per hour. The stone is carried from the crushers in elevators to the bins above, after being screened in large rotary screens. A chute for sand is also provided and into this the sand is dumped from the cars as it is brought from the sand-pit and carried in an elevator to the sand bin in the upper part of the plant and adjoining the stone bins. From these bins the sand and crushed stone is fed by machinery into the hoppers of the mixers. At this place the cement, which is delivered here from the cement house on a belt conveyor, is added and the proportion of sand, stone and cement is properly measured to insure an even mixture of the proper consistency. The mixing machinery consists of four 5-foot cube mixers, mixing $2\frac{1}{2}$ cubic yards at a time. After the usual revolutions of this cube and the concrete being mixed, water being added as the cube revolves, the concrete is dumped from the mixers into large bottom-dumping concrete buckets, resting on cars. These cars are then pulled by mules either to the dam or in the opposite direction to the block yard. There is a series of 8 narrow gauge tracks to the dam and two, branching off into four, to the block yard. The cement house is situated at the western side of the plant and a standard gauge spur track delivers the car loads of cement at the door. The mixing and crushing machinery is driven by a Chandler & Taylor engine, the steam being furnished from the boilers at the compressors.

The concrete block yard, situated west of the main plant, is where the concrete blocks for the facing of the dam and the blocks forming the expansion joints are built. The blocks are cast in forms or molds, made of wood, with one side lined with sheet steel to give the exposed side of the block a smooth surface. There are about 350 of these molds; they are bolted together and can be used over again and again. The blocks vary in size from $2\frac{1}{2}$ to 7 feet and the shape also varies as the dam increases in height. The yard is equipped with 10 guyed derricks with 90 foot booms.

These derricks are also equipped with American Hoist & Derrick Co. engines and stand in a parallel line. There is a double-track, narrow gauge railroad in the centre of the yard and on this travels

the building platform. This platform is built on trucks and is high enough to pass over the forms or molds. It is 12×24 feet and is covered with sheet steel to make a smooth shovelling face. The concrete is brought from the mixer to the platform, where it is dumped, and from here it is shovelled into the forms, which are placed on all sides; as these are filled, the platform is moved and the same performance repeated. After the concrete has been in these molds about 48 hours, the bolts and the sides of the molds are removed and the blocks are left to dry for several days and are then piled up on sticks. After they have seasoned for at least 3 months they are loaded on cars and taken to the dam, where they are placed in the masonry. The yard has a daily average of building about 180 yards.

Just across the main line of the railroad is the power plant, one of the best equipped power plants in operation on construction work, and one of the greatest points of interest. The plant consists of a battery of five 500 horse-power Babcock & Wilcox water tube boilers, which furnish the steam for driving the four large air compressors, built especially for the contractors by the Ingersoll-Rand Drill Co. of Tarrytown, N. Y. Two of these machines are of 500 horse-power each and did service at the Wachusett Dam and the Cross River Dam; the other two are new machines and have a horse-power of 450 each. These machines are compound condensing engines and are equipped with the necessary inter and after coolers for cooling the air. The only steam visible at the plant is to be seen when the huge whistle, which can be heard for miles up the valley, notifies the men of the start and finish of their days work. The larger machines have a capacity of 3500 cubic feet of air per minute, while the capacity of the smaller ones is 2500 cubic feet per minute. The air is carried by an iron pipe line to nearly all parts of the work, including the quarry. The coal is delivered to the plant by an overhead trestle and is dumped from the bottom-dumping coal cars into the large bins. Together with the coal consumed by the locomotives and steam shovels there is a monthly consumption of nearly 1400 tons. All coal is furnished by the Skeele Coal Co. In this same plant two dynamos are also installed for lighting the camp and the work; one is of 250 volts, 140 amperes, and the other a smaller one of 125 volts and 80 amperes. The former is directly connected to steam turbines and the latter is driven by an Erie City engine. A store-house for storing the oils is built near at hand.

At the end of McClellan Ave. and at the down-stream side of the dam is the main machine, blacksmith and wheel-wright shop. The

main blacksmith shop has 6 forges, all driven with compressed air, one 400 lb. and one 200 lb. trip-hammer, 1 bolt machine and 1 punch and shears for heavy sheet iron work, besides all the smaller tools necessary. At all parts of the work smaller shops are installed for sharpening tools, shoeing and making repairs to plant etc. The machine shop adjoining is equipped with the following machinery, driven by an Erie City engine of 20 horse-power: 1 planer, 1 radial drill, 1 Bickford boring mill, 4 lathes, 1 upright drill, 1 Acme bolt cutter, 2 pipe machines, 1 nut tapper, 1 automatic air drill, 1 screw press and a large travelling crane for carrying engine bodies and heavy machinery about the shop. The wheel-wright shop, where all wagon repairing and wood work as well as the building of new wagons is done, has a forge, a band and circular saw, planer and tenon machine.

The tool-house, a separate building, is fully equipped with a complete line of fittings for all kinds of pipe, repairs and parts for all the machinery in use on the work, oils of all grades, waste and in fact everything needed in the operation of the work. Near here there is a large warehouse, 30 feet wide and 200 feet long, of very heavy construction, for the storage of plant during the winter months and where the same can be overhauled and repaired. In close proximity a building is also erected for storing the many steam rollers during the winter months.

The railroad system installed here, one of the best equipped of its kind on any construction work, and one of the busiest departments, is described as follows: The main line, a double-track road, runs from Brown Station to the main plant at the dam and from here the various side tracks for the block yard, cement house, coaling siding and the various yard tracks leave the main line. The line leads off from here into the quarry branch, which crosses the Esopus Creek about $\frac{3}{4}$ of a mile from the dam on a steel viaduct 85 feet high and 390 feet long, entering the quarry on a switch-back at an elevation more than 200 feet above the tracks at the dam. Another branch leaves the main line here also for the compressor coal pockets and one to the sand pit. Leading off from the quarry line at the end of the double track is the west channel branch and another on the opposite side leads to the various borrow pits, where earth is excavated with steam shovels for the various embankments. Near the power plant is a branch leading to the west dike around Winchell Hill. There are two more branches leading off from this line to the north wing, one of which supplies sand, stone and cement to the



Main Dam (looking South). High Point Mountain in the distance.

concrete mixing plant and the other delivers the earth for the embankment. The middle dike branch leaves the main line near Brown Station and crosses the U. & D. R. R. twice on overhead crossings. It is double-tracked for its length between these two crossings. A branch leads off this for the dividing weir and from this line also branches the discharge channel branch. A short spur gives access to the aqueduct. A branch has also been built to the bakery off the main line for unloading flour etc.

The main yard at the dam has 8 tracks and there is a repair spur to the shop for the delivery there of heavy machinery and also a track to the car repair shop, where the necessary repairs are made. A large modern round-house and turntable is also built near the shop, with ash and repair pits, and has accommodations for the nine locomotives. The rolling stock of the department consists of 9 large standard gauge locomotives, built by the American Locomotive Works, these being of the saddle tank type, 96 flat cars equipped with air, 5 gondolas, 75 Western side-dump cars and about 25 narrow gauge cars with two narrow gauge Porter locomotives. An American Hoist & Derrick Co. crane is always in operation along the railroad for the handling of plant stored along the track and was used successfully in the laying of the track and erecting overhead bridges; in fact, there is hardly a day when there is not some work for it to perform. The total trackage, including all the branches, is about 20 miles, all of extra heavy rail laid on first class ties. All switches are provided with the necessary stands and lamps and there are flagmen stationed at all crossings to avoid accidents to the public as well as to employees.

Leaving the dam, the remainder of the work consists principally of the earth dams, which are called dikes, and these are made up of the south and north wing, west, middle and east dike, dividing weir and the waste weir, which is of masonry. A description of the typical dike is as follows: The entire area of the dike is first stripped of all surface soil and all vegetable matter is removed. A vertical trench is then excavated along the centre line to either rock or hard-pan, if the latter is found suitable for a foundation. The depth of this trench will vary on different parts according to the geological formation of the earth. A concrete core wall is then built in this trench, the average width or thickness of which is about 10 feet at the bottom and 5 feet on the top. After the concrete is hardened, the wooden forms are removed and the space between the concrete and the original earth is filled with clay and tamped up to the original surface of

the ground. At this point the embankment proper is started by spreading the clay in layers 3 inches thick on the upstream and 6 inches on the downstream side; this is then rolled with heavy steam rollers, the Monarch roller being used almost exclusively. These embankments vary in width and in some places are nearly 800 feet wide; they have a gradual slope to the top, which is in all places 34 feet wide and will eventually be traversed by a highway. On the outer side of the clay embankment and on the slopes there is a layer of stone to add weight and this is again covered with clay and the top soil, which was previously removed from the area, is placed on this clay and will later be grassed. These earth dams, together with the masonry part of the main dam, have a combined length of nearly four miles.

The plant installed and the methods of building these dikes is described as follows: South wing. Here, for the stripping, no plant aside from wagons and mules was needed; the excavation for the core wall was done with a Page excavator and derricks. For the concrete work a quarry was opened about $\frac{1}{4}$ mile distant to supply the stone and a No. 5 Gates crusher was installed. The sand was hauled here with wagons, as the work was on the opposite side of the river and not accessible by trains. The stone, after being crushed, was carried by an elevator into a bin and from this, together with the cement and sand added, was mixed by a No. 4 Ransome mixer. The concrete was hauled in small narrow gauge cars to the derricks, where it was deposited in the forms. These derricks were equipped with American Hoist & Derrick Co. engines. For building the embankment there is a 70-ton Bucyrus steam shovel working in a borrow pit and loading the earth into dump cars, of which there are 20. As the cars are loaded, they are hauled by two 18-ton Vulcan narrow-gauge locomotives to the place of disposal. The earth is then spread in layers and rolled with a Monarch steam roller. A Star well drilling machine is used for blasting ahead of the shovel. The quarry referred to above has not been worked to its capacity, owing to conditions at the mixer, and has turned out about 150 yards per day. The mixing plant has a maximum output of 226 yards of concrete in 8 hours. The crusher and mixer are operated by steam, there being two boilers and an engine installed. There is about 2 miles of narrow gauge track and about 40 mules have been engaged on this part of the work, where the Eagle dump wagon has been very much in evidence for the various hauling. There is also built here for construction purposes a machine shop, blacksmith shop, powder magazine and cement house.

North wing. Here the soil stripping was done in the same manner as at the south wing and the excavation for the core wall was done with travelling derricks; for the concrete work there is installed a mixing plant with a 5-foot cube mixer. After the mixing, the concrete is delivered in cars to the derricks, where it is placed in the forms. The material for the mixers is brought by trains from the main crusher and sand pit and cement in car-loads. The material is brought from the borrow pits by trains for the embankment and after being spread is rolled with a Monarch. The boulders encountered in the clay are placed on the rock embankment on the outer sides and this is the rule on all the dike work.

West dike. Just over Winchell Hill from the north wing is the west dike. After the soil had been removed in the regular way, the core wall was excavated with a page excavator and travelling derricks. Considerable rock had to be removed here, it being the valley of the Hog Vly Kill. A cable-way similar to those at the dam, with a span of 1534 feet was installed here and handled part of the excavation and the concrete, and will also be used to some extent in building the embankment. A mixing plant with a 5-foot cube mixer is installed here and the material supplied by trains as on the north wing. The mixed concrete is hauled in buckets on cars under the cable-way and thence to the core wall. Prior to the installation of this plant considerable concrete was mixed with a portable mixer at the east and north end of the dike. The material for the embankment is hauled here in Eagle wagons from the west channel excavation and from borrow pits and after being spread is rolled by a Monarch.

Middle dike. The middle dike is the longest of the dikes and for construction purposes is divided into a west, middle and east portion. The work on the west portion was done in practically the same manner as the west dike, except that there is no mixing plant or cable-way and the mixing of the concrete was done with a portable mixer. The material for same was delivered along the middle dike branch of the railroad and the material for the embankment will be delivered likewise from the borrow pits.

The middle section or Beaver Kill, being the valley of that stream, has been a very heavy piece of dike work. The stream of the Beaver Kill has been diverted and now passes through a concrete conduit in the dike, which will eventually be closed with masonry. After the soil was removed and in order to get a foundation for the core wall, it was necessary to excavate to a depth of over 80 feet through

glacial drift. A cable-way of 1534 foot span and similar to the others previously described was installed and a great amount of the excavation was handled in this manner. A mixing plant was also installed with a 5-foot cube mixer, being supplied in the same manner as at the west dike and north wing plants. The cable-way handled the concrete from the mixer and delivered it to the core walls. A large storage bin is erected here, where stone and sand for the east portion and the east dike and waste weir is deposited, as this is the present terminus of the railroad. The sand and stone is hauled in Eagles from here to the work. The material for the embankment is obtained from borrow pits near at hand and hauled in Eagle wagons and some is delivered under the cable-ways by trains from the various borrow pits near the dam. The greater part of the excavation on this section was done with a Page excavator and travelling derricks.

The plant installed for the embankment purposes on the north wing, west dike and the west and middle portions of the middle dike, besides the railroad line already described are:

- 2 70 ton Bucyrus steam shovels
- 1 70 ton Atlantic steam shovel
- 1 30 ton Atlantic traction shovel
- 1 30 ton Ohio traction shovel
- 2 Model 20, Marion traction shovels
- 8 Monarch steam rollers
- 1 Kelley-Springfield roller
- 2 Western graders
- 2 Road machines
- 2 Buffalo traction engines

This same plant will also be used during the construction of the dividing weir dike later.

For the various kinds of hauling and team work at the main dam and main camp and the north wing, west dike, west and middle portion of the middle dike and vicinity there are provided the necessary wagons, 80 2 and 3 mule Eagles, some Watson and Studebaker, scrapers, both drag and wheeled, and wagons and carts of nearly every description. All of the mules for this part of the work are quartered at the main barns; there are 235 mules and about 20 horses for various purposes. These together with the horses and mules on the work at the south wing, east portion of middle dike and east dike, make a total of 64 horses and 365 mules. Oats, hay and other feed is delivered in car-load lots.



Scene at Main Dam, showing cable-way towers, crusher and railroad yard.


East portion middle dike. This section of the dike lays on fairly high ground. After the removal of the top soil two travelling derricks were used for the excavation of the core wall and these same derricks, equipped with American Hoist & Derrick Co. engines, were used for the placing of the concrete. Here a Chicago Municipal portable mixer was used and the concrete material was hauled from the Beaver Kill bins. For embankment material a 70 ton Atlantic shovel is used in connection with a narrow gauge railroad with about two miles of track, 40 3-yard cars and 2 Vulcan narrow gauge locomotives. The earth, after being spread, is rolled by a Monarch roller. A cement house and machine shop are also erected here. About 40 horses and Eagle wagons were also used for miscellaneous hauling.

East dike. This is the eastern end of the dikes and a portion of it crosses a marsh, where considerable water was encountered in the excavation of the core wall trench after the removal of the soil. This excavation was carried on with the use of two travelling derricks, and the same derricks were used for the placing of the concrete. A No. 5 Gates crusher is installed here and the stone was taken from the excavation and from a small quarry near at hand. The sand was hauled, however, from the Beaver Kill bins. A Smith mixer has been used for mixing the concrete and a battery of boilers installed with an engine for furnishing the power. A 100 horse-power air compressor was also installed and furnished air for drills etc. For the embankment work a Vulcan and a Thew shovel are used, together with the narrow gauge railroad with two miles of track. The rolling stock consists of 2 Porter locomotives and 50 narrow gauge side-dump cars.

About 90 mules and several horses are used for various purposes. The waste weir, over which will flow the waste water from the reservoir during the greater flood times, will be a masonry dam 1000 feet long and will have an average height of about 10 feet. The masonry in this has not been started, but the excavation is about completed.

Dividing weir. At the intersection of the west and middle dike is the beginning of the aqueduct which will eventually carry the water to New York. At the head of the aqueduct is the gate chamber, in which will be installed the necessary valves, gates etc. A cable-way, a Lidgerwood of 1150-foot span, is installed here and has a head-tower 100 feet high and a tail-tower of 90 feet. This, together with a few derricks and steam shovels, will make the excavation and a mixing plant with a 5-foot cube mixer is being installed for the concrete work. Leading off both east and west from the gate house are the inlet channels, which carry the water from either basin to the gate house. They have a combined length of 8800 feet and an average depth of 50 feet and the west channel has a maximum depth of 80 feet. The dividing weir and dike starts at the gate house and runs to Green Hill, dividing the reservoir into an east and a west basin. A portion of it is an earth dam and dike of about 1000 feet and the remaining 1100 feet is a masonry dam. A shallow channel will carry the water, as it overflows the masonry portion during the flood times, to the east basin, from where it flows to the waste weir and wastes over this down through the Stone Church spillway back into the old bed of the Esopus a few miles below the main dam.

Main Camp

 THE MAIN CAMP on the Ashokan Dams contract is located on Winchell Hill, between the Ulster & Delaware R. R. and the Olive Bridge Dam. The camp lies on the gradually sloping hillside, which furnishes natural drainage, and never during the longest rainy seasons is there a pool of water anywhere in the camp where a dog could quench its thirst.

The first sight of the camp or knowledge of same when alighting from the trains at Brown Station is the "Hack to the Camp", which carries people to and from the station.

The main line of the contractors' railroad, a double-track standard railroad, runs through the camp. All street crossings are protected by the usual white sign-board, such as is used by all railroads, and in addition, during the time the trains are running, are protected by a flagman. Main Street, the principal thoroughfare, runs parallel with the railroad from Brown Station to the Olive Bridge Dam. South of the railroad, and running parallel are Burr, Freeman and Stearns Streets. Metz Avenue crosses these streets and terminates at Main Street, just across the railroad. Shaw Ave., starting at the eastern end of these three streets, runs north, crossing the railroad at the bakery, and thence north past the office, branching off into the two residential avenues, Bensel and Chadwick. At the beginning of Bensel and Chadwick Aves. School Street has its origin and runs west towards the Camp School. Half way between the police station and the school-house Gaynor Avenue leaves School Street and runs north, parallel with Bensel Ave. Jones Street runs off Main Street at the hospital and crosses Chadwick and Bensel, terminating at Gaynor Ave. McClellan Ave. leaves Main Street just east of the commissary and runs west past the office and boarding camp to the machine shops at the Olive Bridge Dam.

These streets are all lighted with electric lamps at night and during the dry season are kept sprinkled and the *water wagon* is very much in evidence.

After leaving Brown Station and coming up Main Street, the first building of note on the left and just past the Brown Station Post

Office is the Ashokan National Bank. The bank is capitalized at \$25,000.00 and the stock is held practically by employees and local men. The paymaster's office of MacArthur Bros. Co. and Winston & Co. is in the bank and employees can draw their money at any time they see fit, the pay being made up and checks handed them weekly. A great many of the men have no safe way of taking care of their savings, except in their pockets, and this institution has satisfied a long-felt want. Interest is paid on deposits in the savings department and there is hardly a man at the camp who does not carry his brass check and a pass-book from the Ashokan Bank. This bank was opened for business about the first of August and the deposits will reach more than \$100,000 by the end of the year 1909. After passing the bank you will observe several of the special types of dwellings built for employees and as you proceed further and across the railroad you come to the hospital, on the left and further up the street the commissary department, both of which will be described in more detail.

Opposite the commissary and facing on McClellan Ave. is the office of MacArthur Bros. Co. and Winston & Co. The office is almost centrally located and north of it are the dwellings for the American families, to the south the Italian and foreign camp and to the east the negro camp. There are also houses for Italians and foreigners at the extreme north end of the camp and to the west. The main office building is a two story frame structure and furnishes offices for the executive staff, engineering staff, mechanical department and the time and book-keeping departments. A large fire-proof vault is built in the building, which contains filing arrangements for all the records etc. The dark-room for all photographic and blue-print work is on the top floor and fully equipped to carry on this part of the work.

The reservoir for the water supply is situated on the top of Winchell Hill, overlooking the entire camp, and the sewage disposal works are on the brow of the hill at the extreme southern part of the camp, overlooking the Esopus; both of these will be described in more detail.

The arrangement of the houses is so that each tenant has a certain



Yale Quarry, which furnishes the stone for the masonry.

plot of ground in connection with his house. Here are the gardens with all the vegetables of the season and as the men work only eight hours a day, they have ample time to attend to their gardens and furnish their tables with fresh eatables. The front yards of most of the houses have nice little patches of flowers and these are the pride of the camp.

Another scene in the early evening is the Italian men at play in the "courts", one of which is built at nearly every house, and where they play their native game with large wooden balls. The colored men usually follow the old-time custom of congregating at the store after working hours, and after making their purchases for the following day, sit around on the porch and tell stories of the sunny south, whence nearly all of them hail.

An athletic association has been organized in the camp and most of the younger men of the skilled labor class are members. A base ball ground has been graded near the camp and every evening a crowd goes there for practice and pastime. The crack team of the camp during the season of 1909 played in a series of games with Olive Bridge and Shokan for a beautiful silver cup, presented by Mr. B. A. Powell, and after a hard fight won by one game. The series with the B. W. S. Engineers' Team was lost after a hard struggle and the cup donated by Mr. Breuchaud and Mr. Harrison went to the engineers. The games were played after working hours, giving all the people a chance to see them. At the close of the base ball season a foot-ball team was organized and these games will furnish the sport for the fall months.

A large band-stand has been erected near the office and open air band concerts were conducted every Saturday night during the summer and continued until the nights became too cold. The band was made up of employees and during the greater part of the season there were 14 members. These men are paid for their services by the contractors; during the summer the people spending their vacations in the neighborhood always drove to camp on Saturday nights for the concerts.

Amusement is furnished a great many of the men by the pool-room at the bank building, where they are also supplied with lunches, cigars and soft-drinks. Newspapers and periodicals are also handled here, and a full line of candies for the ladies and children. A barber shop and baths are also in the same building, with two barbers in attendance.

There are three churches for the people in the camp, a Catholic,

Union and a Colored church. In connection with the Catholic church there is a large hall with hard-wood floor, which is used for dances throughout the year. Concerts and entertainments are held occasionally and in this way the monotony of the camp life is broken.

The population in the camp is a very mixed one and among the Americans there are 27 states represented.

The foreigners are representatives of many lands and one can enter the commissary during the rush hours, between 4 and 6 p. m., and hear any of the following languages spoken: Italian, both northern and southern; Polish, Russian, Slovenic, Spanish, French, German, Danish, Hungarian, Roumanian, Slovak and many others.

The population of the camps during the busy season of 1909 was as follows:

| | Men | Women | School | Infants |
|-------------|------|-------|--------|---------|
| South wing | 250 | 8 | 10 | 3 |
| Main camp | 1800 | 250 | 160 | 281 |
| Middle dike | 350 | 10 | 8 | 5 |
| East dike | 220 | 14 | 5 | 3 |
| Total | 2620 | 282 | 183 | 292 |

About 150 of the employees reside in neighboring towns.

The boarding house department for the skilled labor and office men consists of the kitchen and dining room and seven dormitories. The kitchen and mess hall building is a T-shaped building with the central part two stories high, which part furnishes sleeping apartments for all help in the kitchen. The main dining room has a seating capacity of 200 people. The tables are arranged on both sides of the room, leaving the centre aisle free for the waiters; during the noon hour a great many men who live at home or away from the camp take their lunch here and it is the busiest place on the work. The private dining room at the other end of the building has a seating capacity of about 20 and is used for entertaining visitors and sight-seeing parties, who are daily at the camp. It is also used for entertaining visiting engineering societies and at times the large dining room is used and is taxed to its utmost capacity, as on the occasion when the A. S. C. E. paid their visit, when over 500 people were provided with the necessities of life.

The building is built of the usual framing timbers and covered with one-inch boards and ceiled inside with tongue and groove pine or hemlock. The outside and roof are covered with Amazon or Paroid

roofing, which are both perfectly air and water tight and to a great extent fire-proof. The kitchen is fitted up with a large Bramhall-Deane range, portable oven and facilities for heating water, while a large refrigerator is built in the building. There is a day and night chef and meals are served at almost all hours because of the several 8 hour shifts worked by the men.

The dormitories are of about the same construction as the mess hall and are 30×90 feet with covered porches on either end. There are seven of these buildings and each one is provided with a bath and toilets, with direct sewer connection. In one end of each building is a wash room with hot and cold water and the other end is used as a reading and smoking room and here is where one hears the stories of the railroads and other large works since the year of one. The seven dormitories have an aggregate of 91 sleeping rooms and each is fitted with a white enamel bed; several of the larger rooms have 2 beds, where relatives or friends from home can room together. Two of the dormitories are heated with steam, others by stoves.

The commissary department consists of the store, bakery and ice and cold storage houses. The store is a large two-story building and is divided into two departments. In one is handled: Clothing, shoes, notions, dry-goods and everything connected with a general store. The laundry for the men is also sent out from this department. In the other is carried a complete line of cigars and tobacco, groceries, bread and cakes, meats, vegetables etc. The second floor is used for storage purposes and there is a cellar under half the building, where potatoes etc. are stored for the winter. The ice house has a capacity of supplying the entire works and surrounding community during the summer and the ice wagon makes two daily trips around the entire works, in addition to the three delivery wagons run by the commissary department. The bakery has two large ovens and six men are employed here. It has a capacity or daily average during the busy season of 2300 loaves of bread, 300 pies, besides all the cakes, hot rolls etc., which are handled daily in the store. The cold storage house provides for the proper icing and care of meats, which during the summer is very essential.

The hospital and nurses' cottage are located on Main Street, between Brown Station and the office, and is nearly centrally located. It is situated between the street and the railroad, so that it is accessible from either in case of accidents. An ambulance is kept in readiness at all times and there are emergency bags at different points,

containing bandages, antiseptics etc. for first aid in case of accidents. The hospital building contains one ward of 8 beds, one ward of 10 beds, two of 2 beds each and a private room with 1 bed. The average number of patients in the past has been about five.

Entering from the street, one steps into the large sun parlor, one end of which has been converted into a vaccination room; all employees are vaccinated, according to orders of the State Board of Health. A door leads from this into the dispensary, where all office calls and minor accident cases are attended to. The doctor's private office is situated to the side of the dispensary. At one end of the building is the surgery and preparation room, which is fully equipped for all kinds of surgical work. The bath room and lined closets are just off the wards. There is another large sun parlor on the north-east side of the building. The kitchen, laundry, dining room for the nurses and the heating plant are installed in the basement. A covered passage-way leads from the basement to the nurses' cottage, a four room and bath bungalow.

The hospital staff is made up of Dr. J. V. Hibbard with one assistant, Dr. Knapp, one graduate and two pupil nurses, orderly, maid, cook and laundress.

An organized fire department is maintained in the camp, having been organized in January 1909, with a chief, four fire chiefs and twenty volunteer firemen. A reel and hose house has been built in the central part of the camp, in the tower of which has been placed a bell for alarms; in addition to this, all alarms are given by blasts from the compressor whistles. Fire alarm boxes are placed at various places in the camp and in addition the telephone service throughout the camp enables the person discovering the blaze to notify the compressor almost immediately. The camp is divided into four districts and the blasts from the whistle designate the location of the fire. The reel is equipped with 1000 feet of 2½ inch hose, hooks, lanterns etc. Fire hydrants have been installed throughout the camp and afford a good water pressure from the reservoir on the hill. In addition to this, there are chemical extinguishers distributed throughout the camp, at all the principal buildings and at a great many of the dwellings. During the year the department was called out on July 5 to extinguish a fire in the pile of pulp wood in the railroad yard at Brown Station; on October 9 a small blaze at the main crushing plant caused a few of the firemen to leave part of their dinner and run, and on October 26 the shrill whistles of the compressor roused them from their slumbers at 4:50 a. m., when four blasts of the



South Wing (looking North), showing crushing and mixing plant.

whistle signified that the fire was in the vicinity of Brown Station, where the cable-way tower on the middle dike was on fire. All of these fires were put out with a small loss.

An organized police force is also maintained by the contractors and is composed of a chief and four men. A station house is provided for emergency cases. The principal duty of this department is to guard against the bringing of liquors into the camp, which is strictly forbidden, and to prevent rowdyism, which is not tolerated; the second, and often the first offence results in the immediate discharge of a person caught in any rowdyism or brawl. After January 1, 1910, E. M. Gathright, the newly elected Justice, will hold court of special sessions in the police station building.

To safeguard the health of the vast number of people in the camp it was necessary to at once take steps toward installing a system of sewage, and also to prevent contamination of the waters of the Esopus was made compulsory by the State Board of Health. On April 2, 1909, work was started on clearing the site for the disposal works of the sewage system and the work of excavating the trenches for the sewers was rushed through and by the first part of July the sewage was turned in on the beds. The septic tank, or the outlet of the sewers, is built of concrete and is 30×40 feet and 5 feet deep. All of the sewage empties into this tank and the overflow empties into the filter bed, being carried over the bed in troughs and draining from the troughs onto the bed, which is 60×90 feet and built up of crushed stone and screenings. After the sewage passes through the beds it is carried by a pipe to the brow of the hill overlooking the Esopus Creek and drains down the hillside into the river bed, thoroughly purified of all organic matter. The vast number of lines of sewers extend to all parts of the camp and have a total length of 22,000 feet, or 4.16 miles. There are 50 manholes built over the sewers, affording access to the sewers at this number of points. The latrines, or sanitary conveniences, for the greater number of the houses are built over the sewers — there being a masonry vault — and all sewage passes directly into the sewer, which is flushed every morning. Nearly all of the houses have a connection with the sewer for the sink drains and naturally all baths have direct connection. In addition to these sanitary precautions, all garbage, both liquid and solid, is placed into tight metal receptacles and hauled away and buried every day, there being two scavenger wagons for this purpose alone. All houses are fumigated to prevent the arising of any epidemic and the entire camp is under the strictest inspection by the sanitary inspector of the Board

of Water Supply, the inspector of the State Board of Health and the sanitary department of the contractors. Any employee not complying with the sanitary regulations is considered as having furnished sufficient cause for discharge.

In addition to the sanitary arrangements, the vital issue, the same as has confronted the City of New York, was: Where will we get a good supply of water for our employees? At first a series of springs were used as a base of the domestic supply, but this soon proved to be inadequate. A pipe-line was then laid a distance of nearly 15,000 feet to a spring at the foot of High Point Mountain, which furnished water as clear as crystal and cold, and from a chemical analysis almost pure, or purer than 90 per cent. of the water which the people in the country now drink. On Winchell Hill in the camp there are two large storage reservoirs, one for the general water supply, being supplied by pumps from the Esopus and containing or having a capacity of 200,000 gallons, and the domestic reservoir, built of concrete and masonry with a water-proof roof over its entirety, and having a capacity of 40,000 gallons. The water flows by gravity from the spring into the reservoir and has a fall of over 100 feet. The general supply is used for various construction purposes, flushing sewers, fire lines etc. There are in the camp, in connection with the domestic supply, 31,364 feet of pipe lines, supplying water to all buildings. All of the pipe lines are below the freezing line and there is no trouble during the winter months with frozen water pipes.

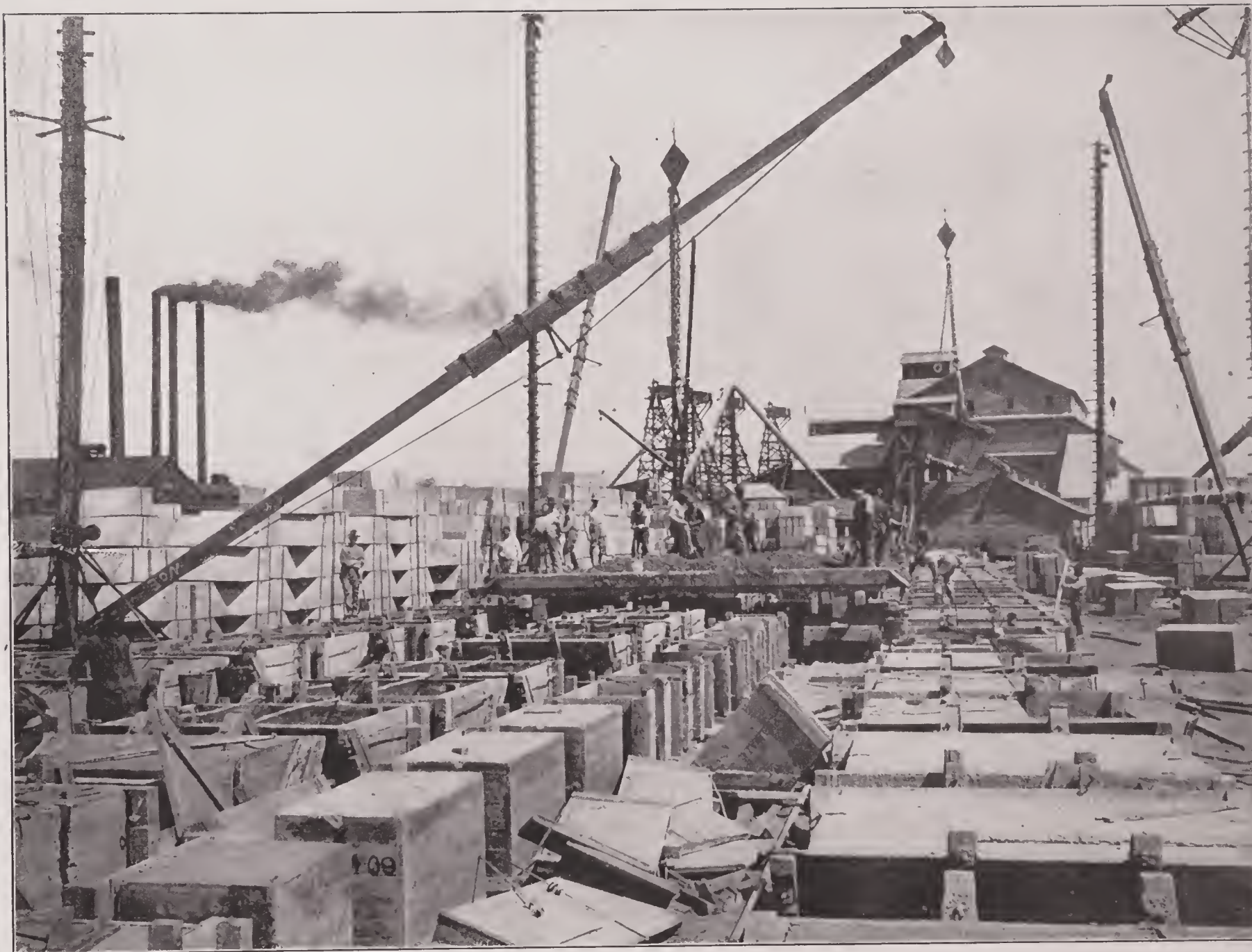
The main camp is made up of the following buildings for the housing and care of the employees etc.

- 1 special 3 room dwelling with bath
- 7 special 4 room dwellings with bath
- 7 special 5 room dwellings with bath
- 7 special 6 room dwellings with bath
- 1 special 7 room dwelling with bath
- 21 standard 3 room dwellings, of which 4 have baths
- 21 standard 4 room dwellings, of which 5 have baths
- 1 standard 3 room dwelling for foreigners
- 81 standard 4 room dwellings for foreigners
- 11 standard 5 room dwellings for foreigners
- 4 standard 6 room dwellings for foreigners
- 20 standard 3 room dwellings for colored people
- 4 standard 4 room dwellings for colored people
- 4 barrack buildings, for men only, of 4 rooms each
- 4 barrack buildings, for men only, of 9 rooms each

- 1 shoemaker's shop
- 1 barber shop
- 1 main office building
- 1 building for B. W. S. engineers
- 1 commissary
- 1 bakery
- 1 flour storage house
- 1 large ice house
- 1 refrigerator house
- 1 kitchen and mess hall
- 7 dormitories
- 1 restaurant
- 2 school houses and 1 district school
- 1 hospital
- 1 nurses' cottage
- 1 fire department hose house
- 1 police station
- 1 band stand

- 1 bank building
- 1 barn for saddle and driving and ambulance horses
- 7 farm houses, repaired etc., for employees.

The standard houses are of one type and are built with the ordinary 2×4 and 2×6 for framing, sheathed with 1 inch boards and ceiled inside with tongue and groove pine or hemlock. The outside and roof are covered with Amazon or Paroid roofing, which is air and water tight, and the floors are all double, with a layer of paper between the boards. They are all built on masonry foundations and in the winter are banked up on the sides around the bottom. In the 4 room type they are built like a 'T' with the kitchen in the back and are provided with both a front and rear porch. The 3 room type is built like an 'L', with both front and rear porches. The special houses are of various types and construction, some being of the same construction as the standard except the shape and arrangement. The amount of rent charged in all cases includes water and fuel and all sanitary conveniences.



Scene at Block Yard, showing the method of building the blocks.

Schools

WHEN THE contract for the main dams was awarded, there was one school of about 20 pupils in the district, situated near Brown Station. The increased population caused by the work put that school in an overcrowded condition during the spring term of 1908. This condition was adjusted in the fall, when Mr. Winston had built and equipped a school house at the camp, and a second teacher was secured for the district. During the fall term the number of pupils continued to increase and a third teacher was employed. In the spring of 1909, conditions were such that another school house was built and the fourth teacher engaged for the fall term.

These four teachers now have under their charge 130 pupils of school age, of which 47 are Americans and the remainder colored and foreigners, the Italians predominating in the foreign element.

In the same building, or the first one built by Mr. Winston, there is maintained by the Society for Italian Immigrants a kindergarten, which now has about 30 children on its roll of from 3½ to 5½ years of age. Here the children of all nationalities are together in charge of an experienced kindergarten teacher and there is a standing invitation to the people of the camp to pay their visits. During the morning there are almost daily visitors and to see the children of all the different nationalities at play and at work is quite interesting. Here you see the little pickaninny trying to carry on an animated conversation with an Italian or some other little foreigner during the time for play or recreation; when they go to work, they are all attention and, as English

is spoken to them by the teacher, they by instinct are very attentive and pick up the language very quickly.

The Society for Italian Immigrants is represented here by Miss Sarah W. Moore, to whom a great deal of credit is due for the success of that part of the school.

The same Society for Italian Immigrants also maintains a school for the adults of all foreign classes, the Italians, however, predominating by a large per cent., in this same building. Here the *green* foreigner receives his first instruction in the English language and as he advances, just as the 6 year old boy, he gets his first reader, and some make remarkable progress and advance very rapidly. They are taught the national songs and sing them in the schools, waving the national flag. The school for adults is held at night between the hours of 7 and 9; there is no charge for tuition and any and all who desire may attend. There are about 75 men enrolled and they attend quite regularly, except when conditions on the work and their hours of duty make it impossible for them to attend. Nearly all the nationalities in the camp are or have been represented, with the Italians in the majority.

These schools take care of the children from the main colony and the children from the south wing, middle dike and east dike camps attend the district schools, which are still kept up in the vicinity of the various camps.

South Wing Camp

THE CAMP for the employees on the south wing is located in a grove of trees on the south bank of the Esopus and about 500 feet distant from the stream. The camp is built along the county highway and has one camp street running through at right-angles from this county highway.

The camp is made up of a commissary, or general store, and the branch office is in the same building. There is also a kitchen and dining room for the skilled laborers and a dormitory, with rooms fitted with white enamel beds, and will accommodate about 40 men. There is a five-room bungalow for the superintendent, and for the colored people and foreigners there are 2 six-room standard houses, 1 five-room and 1 two-room house. There are also 5 barrack buildings for the single men who do not want to board at the houses with the families and who "batch" in these barracks, which have accommodations for about 16 men each.

The buildings are all built of the usual 2×4 and 2×6 framing and covered on the outside with one-inch boards, and these, as well as the roof, are covered with Amazon or Paroid roofing; they are all ceiled inside with tongue and grooved pine or spruce and the floors are double, with a layer of paper between.

The camp is supplied with water from a spring and there is an abundance of pure water for drinking and all other purposes. The sanitary regulations are also strictly observed, as well as on all parts of the work, and the garbage is gathered up daily and hauled away and all sewage is carried in vitrified pipe away from the camp into an abandoned quarry, which makes an excellent disposal bed.

There is also a barn provided for the care of the mules and horses and having accommodations for 50 head of stock.



East Portion Middle Dike Camp

THE CAMP here, located on high ground, consists of a portable houses of five rooms, a branch office, 1 barn, 1 Italian boarding house and 6 dormitories for 30 men each and a commissary. All the buildings, with the exception of the portable house, are of about the same construction as those at the main camp. The same sanitary restrictions are observed and water is furnished from a spring.



East Dike Camp

THIS CAMP is located to the east of the end of the work and an old farm was leased for the purpose and a great many buildings were erected. A branch office has been built here and there is a kitchen and dining room and dormitory for the skilled men with a capacity of about 40 men. There is also a commissary and 4 barracks or dormitories for laborers, for about 30 men each, 4 cottages for foreigners and 4 for American families. The barn has been enlarged and the old farm house is occupied by the superintendent. Here the same sanitary restrictions are observed as in the other camps and an abundant supply of pure water is obtained from a spring.



Train, dumping earth for embankment off the core wall on the North Wing.



Steam Shovel, loading "Eagle Wagons" in borrow pit for embankments.

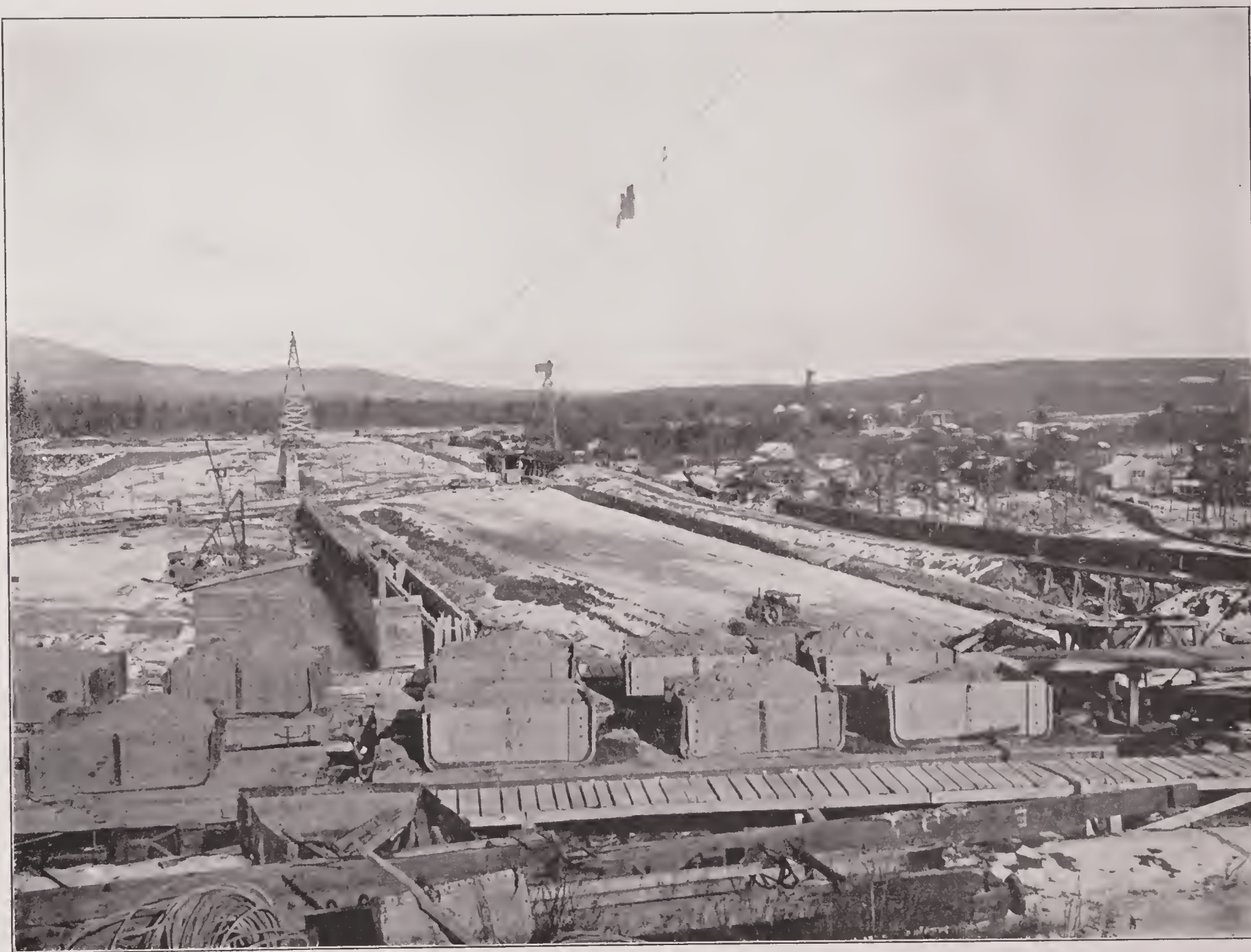
The various kinds of plant installed have been very carefully selected by the contractors, who, by their many years of experience, have used all kinds, and they have spared no expense in getting the very best. All derricks are inspected regularly by men of experience and during the working season this is done every day. All of the requirements of the factory inspector of the State of New York have been complied with in relation to the proper protection of all machinery; railroad crossings are fully protected and sign boards, warning the public of danger, where there is any, are put in conspicuous places. The Hercules Wire Rope, made by A. Leschen & Sons Co. at St. Louis is used

almost exclusively and two of the main cables are furnished by them, the remaining ones by the Trenton Iron Works.

Wagon traffic is forbidden in the vicinity of the dam on account of the vast amount of machinery and train movements, which would be dangerous to the public driving spirited horses.

The entire work is under the sole management of Mr. J. O. Winston, the resident managing partner of the firm, and Mr. M. J. Look is the general superintendent in charge of all construction work. The mechanical department is under the supervision of the master mechanic, Mr. C. H. Peters.





View from Winchell Hill, showing West Dike and Brown Station and three Lidgerwood cable-ways.



Arched Core Wall in Beaver Kill Gorge (the excavation for this was carried to a depth of 80 feet).



A stretch of Core Wall on Middle Dike, and embankment being built against it.



Main Office of MacArthur Bros. Co. and Winston & Co.



Commissary or Store in Main Camp.



Hospital and Nurses' Cottage.



Scene up Chadwick Avenue, showing Special 4-room Cottage in foreground.



Scene up Gaynor Avenue, showing Special 5-room Cottage in foreground.



Mid-Winter Scene on Bensel Avenue.



Typical Italian Camp of the past, as compared with the modern camp at Ashokan.



A Standard 3-room Cottage.



A Special Type Cottage.

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